REMARKS/ARGUMENTS

In response to the Office Action mailed May 18, 2005, Applicants amend their application and request reconsideration. In this Amendment claim 1 is cancelled and is replaced by new claim 7 so that claims 2-7 are now pending.

The Examiner objected to the drawings, asserting that the reference number 19 shown in Figure 1B is not described in the specification. The objection is respectfully traversed. The element given reference number 19 is described in the patent application at page 11 and specifically mentioned in lines 2 and 7 of that page.

The invention concerns a metal electrode and a circuit card to which the metal electrode is joined. The metal electrode includes a wiring layer on a substrate that carries a number of metallic layers sequentially arranged on the wiring layer. The outermost of those layers, the first layer, has an outermost surface of the metal electrode and is the layer opposite and most remote from the substrate. An intermediate second layer is in contact with the first layer. The first layer contains tin and the second layer includes a constituent that forms an eutectic alloy with the tin when joining the metal electrode to the circuit card. In that process, the outermost layer containing tin is brought into contact with a wiring layer of the circuit card. That wiring layer includes a metal that diffuses with tin when subjected to an increase in temperature.

As well known in the art, a eutectic alloy is formed at a temperature below the melting points of the two metals that form the alloy. In the metal electrode, the second layer has a melting point that is lower than the melting point of the first layer, the layer that contains tin. When the first layer is in contact with the joining surface of the wiring layer of the circuit card and the temperature is increased to exceed the eutectic temperature, but not necessarily the melting point of either of the first and second layers, the eutectic alloy is gradually formed between the first and second layers. Further, metal from the wiring layer of the circuit card diffuses into the tin so that a mechanical and electrical connection are formed.

Because of the particular arrangement of the first and second layers, the contact and eutectic alloy are formed controllably. Further, the first layer only slowly becomes molten, if at all, so that a confining resin structure, like the structure H shown in Figure 1A of the patent application, is not readily dissolved and does not mix into the contact being formed. If such mixing should occur, there can be significant problems with the contact.

In this Amendment claim 7 is submitted as a replacement for claim 1 and describes the structure of the invention more clearly. Claims 7 and 2-5 encompass the combination of the metal electrode and the circuit card. The substitute claim makes clear the relationship of the layers of the electrode with regard to the wiring layer and substrate of the electrode, as well as the interaction of the electrode and the circuit card. Independent claim 6 is a method claim and is clarified to describe, in method steps, both the formation of the metal electrode and the circuit card as well as the formation of the bond between the electrode and the circuit card. Newly submitted claim 7 and amended claims 2-6 are clearly supported by the application as filed. For example, the specification at page 16 in lines 15-18, as well as Figure 3, describes and shows the wiring layer and substrate. Diffusion of a metal with tin is described at page 9, lines 5-7, for example.

Claims 1-3 and 6 were rejected as obvious over Parrish et al. (U.S. Patent 6,550,665, hereinafter Parrish) in view of Mertol et al. (U.S. Patent 6,818,996, hereinafter Mertol). This rejection is respectfully traversed.

Parrish is directed to forming contacts between two substrates by bringing together masses or bumps of material on the respective substrates. The bumps of different materials that are in contact are heated to form an electrically conductive eutectic alloy between the different materials of the two bumps. As a result of this alloying, as illustrated in the process depicted in Figures 2A-2D of Parrish, the two substrates are bonded together. While Parrish and the invention both use the concept of eutectic alloys to form connections, the only similarity between the invention as defined by the claims now pending and Parrish is the exploitation of the formation of eutectic alloys.

The invention of claims 7 and 2-5 is directed to a combination of a metal electrode and a circuit card. The metal electrode has sequential layers of metals including the first layer and the second layer that are in contact with each other on the metal electrode and that form a eutectic alloy when heated. The circuit card is clearly separate from the metal electrode until bonded to the metal electrode. There is no element in Parrish like the metal electrode or that suggests the metal electrode. There is no structure at any time in any of the elements illustrated in the cited figures of Parrish in which the two eutectic alloy-forming metal layers are in contact, not yet alloyed, and have an exposed outermost surface of the higher melting point eutectic alloy constituent. While the bringing together of the two substrates in Parrish does place in contact the two eutectic alloy-forming materials, there is

then no exposed surface of either the higher melting point or the lower melting point material because the two substrates obscure those alloy-forming materials and interfere with access to them. No one could reasonably state that the limited side surfaces of those bumps are exposed surfaces that are available for bonding to still another physical element like the circuit card. Therefore Parrish cannot suggest the invention as defined by claims 7 and 2-5.

Mertol does not supply the parts of claims 7 and 2-5 that are missing from Parrish. In fact, the Official Action does not suggest that Mertol supplies these elements. Rather, Mertol was cited as allegedly showing that it is conventional in the art to bond a semiconductor device to a metal electrode with a bump of material. Accordingly, *prima facie* obviousness of claims 7 and 2-5 cannot be established by any combination of Parrish and Mertol.

Claims 4 and 5 were rejected as unpatentable over Parrish, in view of Mertol, and further in view of Homma et al. (U.S. Patent 6,569,759, hereinafter Homma). This rejection is respectfully traversed.

Homma was cited as describing various metal layers that are laminated in a semiconductor device contact. Even if Homma discloses the limitations of dependent claims 4 and 5, Homma does not supply the parts of amended claim 1 that are missing from the purported combination of Parrish and Mertol. Therefore, the addition of Homma cannot establish *prima facie* obviousness as to any claim now pending.

Claim 6 is a method claim directed to the method of bonding together the metal electrode and circuit card that is described in claim 7. Claim 6 has been substantially reorganized and expressly claims the formation of the metal electrode and the circuit card. Claim 6 was rejected on the same basis that claims 1-3 were rejected. For the same reasons already presented, Parrish never describes the formation of a metal electrode nor the bonding of that metal electrode to an element like the circuit card of claim 6.

If it is considered that bringing together the bumps of different materials in Parrish is somehow analogous to forming the metal electrode of the invention, then it is impossible to join that metal electrode to a circuit card, as in the method of claim 6. That method is impossible in Parrish because the two bumps are already connected to respective substrates in forming what the Examiner characterizes as the metal electrode. In other words, claim 6 makes clear that the metal electrode is formed by sequentially arranging the first and second layers of the multiple metallic layers and, subsequently, applying the multiple metallic layers on the substrate to yet another element, the circuit card. Parrish, even as modified by Mertol,

cannot suggest that method because Parrish provides, after joining the bumps together, no access to a first layer of those bumps, i.e., the higher melting point material, for joining to a circuit card. Accordingly, the rejection with regard to amended claim 6 is likewise erroneous and, upon reconsideration, should be withdrawn.

In view of the foregoing remarks, upon reconsideration, all of the claims now pending, claims 2-7, should be allowed.

Respectfully submitted,

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